What is claimed is:

1. A recursive discrete Fourier transformation device wherein data values $x(t), x(t+1), x(t+2), x(t+3), \ldots, x(t+N-1), x(t+N)$ sampled at times t, t+1, t+2, t+3, ..., t+N-1, t+N (N is a positive integer which is 1 or more) each having an equal interval are supplied and as complex Fourier coefficients under degree k (k is 0 or a positive integer smaller than N) obtained by, with such N data values supplied since time t as a data stream, carrying out complex Fourier transformation on the data stream, a real part $X_r(k, t)$ and an imaginary part $X_i(k, t)$ are obtained, the discrete Fourier transformation device comprising:

a first temporary storage means for storing the data stream $x(t), x(t+1), x(t+2), x(t+3), \ldots, x(t+N-1)$ supplied since time t at time t+N-1 temporarily;

a discrete Fourier operation means for obtaining the complex Fourier coefficients $X_r(k, t)$ and $X_i(k, t)$ of the data stream stored temporarily in the first storage means; and

a second temporary storage means for storing the complex Fourier coefficients $X_r(k, t)$ and $X_i(k, t)$ obtained by the discrete Fourier operation means,

the discrete Fourier operation means including:

a subtracting portion for obtaining a data value of a difference between a data value $x(t+N)$ supplied at time t+N and a data value $x(t)$ memorized temporarily in the first storage means;

a constant multiplying portion for obtaining a signal with a predetermined amplitude by multiplying the obtained data value of the difference with a positive constant value A for giving a predetermined amplitude;

an adder portion for obtaining a summed signal by summing the signal with the predetermined amplitude obtained from the constant multiplying portion and one of the real part $X_r(k, t)$ and the imaginary part $X_i(k, t)$ of the complex Fourier coefficients stored temporarily in the second temporary

storage means; and

a basic function arithmetic processing portion for receiving the summed signal obtained from the adder portion and the other of the real part $X_r(k, t)$ and the imaginary part $X_i(k, t)$ of the complex Fourier coefficients stored temporarily in the second temporary storage means and carrying out an arithmetic operation on the received signals using a constant based on a basic frequency thereby to obtain the complex Fourier coefficients $X_r(k, t+1)$ and $X_i(k, t+1)$ at time t+1.

2. A recursive discrete Fourier transformation device as claimed in claim 1 wherein the positive constant value A for providing with an amplitude corresponding to a difference between the x(t+N) and the x(t) is capable of being set selectively with 1, square root of N or 1/N.

3. A recursive discrete Fourier transformation device wherein data values $x(t), x(t+1), x(t+2), x(t+3), \ldots, x(t+N-1)$, $x(t+N)$ sampled at times t, t+1, t+2, t+3, ..., t+N-1, t+N (N is a positive integer which is 1 or more) each having an equal interval are supplied and as complex Fourier coefficients under degree k (k is 0 or a positive integer smaller than N) obtained by, with such N data values supplied since time t as a data stream, carrying out complex Fourier transformation on the data stream, a real part $X_r(k, t)$ and an imaginary part $X_i(k, t)$ are obtained, the discrete Fourier transformation device comprising:

a first temporary storage means for storing the data stream $x(t), x(t+1), x(t+2), x(t+3), \ldots, x(t+N-1)$ supplied since time t at time t+N-1 temporarily;

a discrete Fourier operation means for obtaining the complex Fourier coefficients $X_r(k, t)$ and $X_i(k, t)$ of the data stream stored temporarily in the first storage means; and

a second temporary storage means for storing the complex Fourier coefficients $X_r(k, t)$ and $X_i(k, t)$ obtained by the discrete Fourier operation means,

wherein the discrete Fourier operation means obtains complex Fourier coefficients $X_r(k, t)$ and $X_i(k, t)$ according to following equations.

$$X_r(k,t+1) = \left\{X_r(k,t) + \frac{1}{A}[x(t+N) - x(t)]\right\} \times \cos\left[2\frac{\pi k}{N}\right] + X_i(k,t)\sin\left[2\frac{\pi k}{N}\right]$$

$$X_i(k,t+1) = X_i(k,t)\cos\left[2\frac{\pi k}{N}\right] - \left\{X_r(k,t) + \frac{1}{A}[x(t+N) - x(t)]\right\}\sin\left[2\frac{\pi k}{N}\right]$$

where, A is a positive constant value for providing [x(t+N)-x(t)] with an amplitude.

4. A recursive discrete Fourier transformation device as claimed in claim 3 wherein the positive constant value A for providing with an amplitude corresponding to a difference between the x(t+N) and the x(t) is capable of being set selectively with 1, square root of N or 1/N.

5. A recursive discrete Fourier transformation device wherein data values x(t), x(t+1), x(t+2), x(t+3), ..., x(t+N-1), x(t+N) sampled at times t, t+1, t+2, t+3, ..., t+N-1, t+N (N is a positive integer which is 1 or more) each having an equal interval are supplied and with such N data values supplied since time t as a data stream, complex Fourier transformation is carried out to the data stream using a plurality of degrees k (k is 0 or a positive integer smaller than N) so as to obtain real parts $X_r(k, t)$ and imaginary parts $X_i(k, t)$ as plural sets of complex Fourier coefficients, the discrete Fourier transformation device comprising:

a first temporary storage means for storing the data stream x(t), x(t+1), x(t+2), x(t+3), ..., x(t+N-1) supplied since time t at time t+N-1 temporarily;

plural discrete Fourier operation means for obtaining the complex Fourier coefficients $X_r(k, t)$ and $X_i(k, t)$ for the data stream stored temporarily in the first storage means

for each of plural k values; and

a second temporary storage means for storing each set of the complex Fourier coefficients $X_r(k, t)$ and $X_i(k, t)$ obtained by the plural discrete Fourier operation means corresponding to each k value,

the discrete Fourier operation means including:

a subtracting portion for obtaining a data value of a difference between a data value x(t+N) supplied at time t+N and a data value x(t) memorized temporarily in the first storage means;

a constant multiplying portion for obtaining a signal with a predetermined amplitude by multiplying the data value of the difference obtained by the subtracting portion with a positive constant value A for giving a predetermined amplitude;

an adder portion for obtaining a summed signal by summing the signal with the predetermined amplitude obtained from the constant multiplying portion and one of a real part $X_r(k, t)$ and an imaginary part (k, t) of the complex Fourier coefficients stored temporarily by the second temporary storage means; and

a basic function arithmetic processing portion for receiving the summed signal obtained from the adder portion and the other of the real part $X_r(k, t)$ and the imaginary part (k, t) of the complex Fourier coefficients stored temporarily in the second temporary storage means and carrying out an arithmetic operation on the received signals using a constant based on a basic frequency thereby to obtain complex Fourier coefficients $X_r(k, t+1)$ and $X_i(k, t+1)$ at time t+1.

6. A recursive discrete Fourier transformation device as claimed in claim 5 wherein the quantity of the degrees k is N.

7. A recursive discrete Fourier transformation device as claimed in claim 5 wherein the positive constant value A

for providing with an amplitude corresponding to a difference between the x(t+N) and the x(t) is capable of being set selectively with 1, square root of N or 1/N.

8. A recursive discrete Fourier transformation device wherein data values x(t), x(t+1), x(t+2), x(t+3), ..., x(t+N-1), x(t+N) sampled at times t, t+1, t+2, t+3, ..., t+N-1, t+N (N is a positive integer which is 1 or more) each having an equal interval are supplied and with such N data values supplied since time t as a data stream, complex Fourier transformation is carried out to the data stream using a plurality of degrees k (k is 0 or a positive integer smaller than N) so as to obtain real parts $X_r(k, t)$ and imaginary parts $X_i(k, t)$ as plural sets of complex Fourier coefficients, the discrete Fourier transformation device comprising:

a first temporary storage means for storing the data stream x(t), x(t+1), x(t+2), x(t+3), ..., x(t+N-1) supplied since time t at time t+N-1 temporarily;

plural discrete Fourier operation means for obtaining the complex Fourier coefficients $X_r(k, t)$ and $X_i(k, t)$ for the data stream stored temporarily in the first storage means for each of plural k values; and

a second temporary storage means for storing each set of complex Fourier coefficients $X_r(k, t)$ and $X_i(k, t)$ obtained by the plural discrete Fourier operation means corresponding to each k value,

the discrete Fourier operation means including:

a common subtracting portion for obtaining a data value of a difference between a data value x(t+N) supplied at time t+N and a data value x(t) memorized temporarily in the first storage means;

a common constant multiplying portion for obtaining a signal with a predetermined amplitude by multiplying the data value of the difference obtained by the common subtracting portion with a positive constant value A for giving a predetermined amplitude;

an adder portion for obtaining a summed signal by summing the signal with the predetermined amplitude obtained from the common constant multiplying portion and one of a real part $X_r(k, t)$ and an imaginary part (k, t) of the complex Fourier coefficients stored temporarily in the second temporary storage means; and

a basic function arithmetic processing portion for receiving the summed signal obtained from the adder portion and the other of the real part $X_r(k, t)$ and the imaginary part $X_i(k, t)$ of the complex Fourier coefficients stored temporarily in the second temporary storage means and carrying out an arithmetic operation on the received signals using a constant based on a basic frequency thereby to obtain the complex Fourier coefficients $X_r(k, t+1)$ and $X_i(k, t+1)$ at time t+1.

9. A recursive discrete Fourier transformation device as claimed in claim 8 wherein the quantity of the degrees k is N.

10. A recursive discrete Fourier transformation device as claimed in claim 8 wherein the positive constant value A for providing with an amplitude corresponding to a difference between the x(t+N) and the x(t) is capable of being set selectively with 1, square root of N or 1/N.

11. A recursive discrete Fourier transformation device wherein data values $x(t), x(t+1), x(t+2), x(t+3), \ldots, x(t+N-1), x(t+N)$ sampled at times t, t+1, t+2, t+3, ..., t+N-1, t+N (N is a positive integer which is 1 or more) each having an equal interval are supplied and as a complex Fourier coefficient under degree k (k is 0 or a positive integer smaller than N) obtained by, with such N data values supplied since time t as a data stream, carrying out complex Fourier transformation on the data stream, a real part $X_r(k, t)$ and an imaginary part $X_i(k, t)$ are obtained, the discrete Fourier transformation device comprising:

a data updating means for obtaining a first subtraction signal by subtracting data $x(t)$ supplied before N sampling period from data $x(t+N)$ supplied at time $t+N$;

a recursive processing means for obtaining a new second subtraction signal by subtracting an addition signal generated recursively using an already generated second subtraction signal from the obtained first subtraction signal; and

a multiplying means for obtaining the real part $X_r(k, t)$ of the Fourier coefficients by summing up a signal obtained by multiplying the new second subtraction signal obtained by the recursive processing means with a first constant value and a signal obtained by multiplying the second subtraction signal supplied before a sampling period with a second constant value and for obtaining the imaginary part $X_i(k, t)$ of the Fourier coefficients by multiplying the new second subtraction signal with a third constant value,

wherein the addition signal generated recursively by the recursive processing means is a signal obtained by summing up a signal obtained by multiplying the second subtraction signal obtained before a sampling period with a fourth constant value and the second subtraction signal obtained before two sampling periods.

12. A recursive discrete Fourier transformation device wherein data values $x(t), x(t+1), x(t+2), x(t+3), \ldots, x(t+N-1), x(t+N)$ sampled at times $t, t+1, t+2, t+3, \ldots, t+N-1, t+N$ (N is a positive integer which is 1 or more) each having an equal interval are supplied and as a complex Fourier coefficient under degree k (k is 0 or a positive integer smaller than N) obtained by, with such N data values supplied since time t as a data stream, carrying out complex Fourier transformation on the data stream, a real part $X_r(k, t)$ and an imaginary part $X_i(k, t)$ are obtained, the discrete Fourier transformation device comprising:

a data updating means for obtaining a first subtraction signal by subtracting data $x(t)$ supplied before N sampling

period from data x(t+N) supplied at time t+N;

a recursive processing means for obtaining a new second subtraction signal by subtracting an addition signal generated recursively using an already generated second subtraction signal from the obtained first subtraction signal; and

a multiplying means for obtaining the real part $X_r(k, t)$ of the Fourier coefficients by summing up a signal obtained by multiplying the new second subtraction signal obtained by the recursive processing means with a first constant value and a signal obtained by multiplying the second subtraction signal supplied before a sampling period with the second constant and for obtaining the imaginary part $X_i(k, t)$ of the Fourier coefficients by multiplying the new second subtraction signal with a third constant value,

wherein a transfer function H(Z) for the data updating means, the recursive processing means and the multiplying means connected as subsidiary components is given according to a following equation.

$$H(z) = A\left(1 - z^{-N}\right)\left\{\frac{\cos\left[2\frac{\pi k}{N}\right] - j\sin\left[2\frac{\pi k}{N}\right] - z^{-1}}{1 - 2\cos\left[2\frac{\pi k}{N}\right]z^{-1} + z^{-2}}\right\}$$

where A is a positive constant value for providing [x(t+N)-x(t)] with an amplitude.

13. A recursive discrete Fourier transformation device as claimed in claim 12 wherein the positive constant value A for providing with an amplitude corresponding to a difference between the x(t+N) and the x(t) is capable of being set selectively with 1, an inverse number of square root of N or 1/N.

14. A recursive discrete Fourier transformation device wherein data values x(t), x(t+1), x(t+2), x(t+3), ..., x(t+N-1),

x(t+N) sampled at times t, t+1, t+2, t+3, ..., t+N-1, t+N (N is a positive integer which is 1 or more) each having an equal interval are supplied and with such N data values supplied since time t as a data stream, complex Fourier transformation is carried out to the data stream using a plurality of degrees k (k is 0 or a positive integer smaller than N) so as to obtain real parts $X_r(k, t)$ and imaginary parts $X_i(k, t)$ as plural sets of complex Fourier coefficients, the discrete Fourier transformation device comprising:

plural data updating means corresponding to the plurality of degrees k, for obtaining a first subtraction signal by subtracting data x(t) supplied before N sampling period from data x(t+N) supplied at time t+N;

plural recursive processing means corresponding to the plurality of degrees k, for obtaining a new second subtraction signal by subtracting an addition signal generated recursively using an already generated second subtraction signal from the obtained first subtraction signal; and

plural multiplying means corresponding to the plurality of degrees k, for obtaining a real part $X_r(k, t)$ of the Fourier coefficients by summing up a signal obtained by multiplying the new second subtraction signal obtained by the recursive processing means with a first constant value and a signal obtained by multiplying the second subtraction signal supplied before a sampling period with the second constant and for obtaining an imaginary part $X_i(k, t)$ of the Fourier coefficients by multiplying the new second subtraction signal with a third constant value,

wherein the addition signal generated recursively by each of the plural recursive processing means is a signal obtained by summing up a signal obtained by multiplying the second subtraction signal obtained before a sampling period with a fourth constant value corresponding to each degree k, and the second subtraction signal obtained before two sampling periods.

15. A recursive discrete Fourier transformation device as claimed in claim 14 wherein the quantity of the degrees k is N.

16. A recursive discrete Fourier transformation device wherein data values $x(t), x(t+1), x(t+2), x(t+3), \ldots, x(t+N-1), x(t+N)$ sampled at times t, t+1, t+2, t+3, ..., t+N-1, t+N (N is a positive integer which is 1 or more) each having an equal interval are supplied, data x(t) supplied before N sampling period is subtracted from data x(t+N) supplied at time t+N so as to obtain a first subtraction signal, and with such N data values supplied since time t as a data stream based on the obtained first subtraction signal, a complex Fourier transformation is carried out to the data stream using a plurality of degrees k (k is 0 or a positive integer smaller than N) so as to obtain real parts $X_r(k, t)$ and imaginary parts $X_i(k, t)$ as plural sets of complex Fourier coefficients, the discrete Fourier transformation device comprising:

plural recursive processing means corresponding to the plurality of degrees k, for obtaining a new second subtraction signal by subtracting an addition signal generated recursively using an already generated second subtraction signal from the obtained first subtraction signal; and

plural multiplying means corresponding to the plurality of degrees k, for obtaining a real part $X_r(k, t)$ of the Fourier coefficients by summing up a signal obtained by multiplying the new second subtraction signal obtained by the recursive processing means with a first constant value and a signal obtained by multiplying the second subtraction signal supplied before a sampling period with the second constant and for obtaining an imaginary part $X_i(k, t)$ of the Fourier coefficients by multiplying the new second subtraction signal with a third constant value,

wherein the addition signal generated recursively by each of the plural recursive processing means is a signal obtained by summing up a signal obtained by multiplying the

second subtraction signal obtained before a sampling period with a fourth constant value corresponding to each degree k, and the second subtraction signal obtained before two sampling periods.

17. A recursive discrete Fourier transformation device as claimed in claim 16 wherein the quantity of the degrees k is N.